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Decomposing malnutrition inequalities between Scheduled Castes and Tribes and the remaining Indian population

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Objective. In India, Scheduled Castes and Scheduled Tribes (ST/SC) have been excluded from Hindu society for thousands of years. Together, they comprise over 24% of India's population and still suffer worse health conditions compared to the rest of the Indian population. This paper decomposes the gap in child malnutrition between the ST/SC and the remaining Indian population, looking at both the ST/SC's disadvantageous distribution of health determinants and possible discriminatory or behavioral differences.
Design and setting. A Blinder–Oaxaca decomposition was applied to decompose the gap in children's average height-for-age z scores, using data from the 1998/1999 Indian Demographic Health Survey.
Results. The gap was found to be primarily caused by the ST/SC's lower wealth, education and use of health care services, but also differences in the effects of health determinants played an important role. It was found that within rural areas ST/SC are not necessarily located further from educational and health care facilities.
Conclusions. The use of Oaxaca type decomposition can be very useful when studying ethnic inequalities in health as it explicitly allows for discriminatory or behavioral effects. The results did not point to discrimination against ST/SC regarding health care or education. However, in the quest to increase health care use and education among ST/SC, policy makers will have to take into account all the barriers to these services, including those related to cultural sensitivity and acceptability.

Keywords: child malnutrition; Scheduled Tribes and Castes; India; inequality; decomposition

Introduction

In India, Scheduled Castes and Scheduled Tribes have been excluded from the Hindu society for thousands of years. These communities had traditionally been relegated to the most menial labor with no possibility of upward mobility, and subject to extensive social disadvantage and exclusion, in comparison to the wider community (Dunn 1993). In response, they were accorded special status by the Indian constitution, which designated disadvantaged tribal and caste populations as Scheduled Tribes and Castes (hereafter referred to as ST/SC) and accorded them special protections (Parikh 1997, Planning Commission India 2002). The ST/SC

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comprise over 24% of India's population, with SC at about 16% and ST over 8% as per 2001 census (India Census 2001). Today, they still suffer worse health conditions than the rest of the Indian population. The final report of the 2005/2006 Demographic and Health Survey reported ST/SC to suffer from infant mortality rates of 44 and 51, respectively (per 1000 live births), compared to 36 for the rest of the population (IIPS and Macro International 2007). Furthermore, Subramanian *et al.* (2006b) illustrate the larger adult mortality rates in ST/SC as compared to the remaining population (odds-ratio of 1.28 for the ST and 1.23 for the SC).

The aim of this paper is to fill the paucity of information on ST/SC's disadvantaged position with respect to childhood nutritional outcomes. Malnutrition is an informative health indicator and also one of the major public health problems in India. More than half of the deaths among under-five Indian children are associated with malnutrition and the country has one of the highest percentages of malnourished children across the developing world (UNICEF 2002). Malnutrition is a major public health and development issue, and has foregoing health and socioeconomic impacts. Children who are malnourished tend to have increased morbidity and mortality, are more prone to suffer from delayed mental development, poor school performance and reduced intellectual achievement and have a higher probability to be functionally impaired in adult life (Vella *et al.* 1992, Pelletier *et al.* 1993, Schroeder and Brown 1994, Pelletier *et al.* 1995, Mendez and Adair 1999, Delpeuch *et al.* 2000, Pelletier and Frongillo 2003).

This paper aims at supporting Indian policy makers in their efforts to reduce inequalities in malnutrition rates between the ST/SC and the remaining population, by highlighting those factors that are related to the difference in malnutrition rates between the two groups. This is done by using a Blinder–Oaxaca decomposition which is explicitly developed to explain the gap in outcomes between the two population groups (Blinder 1973, Oaxaca 1973). This decomposition not only allows quantifying how much differences in the distribution of health determinants contribute to the gap in child malnutrition between the ST/SC and the remaining population, but also investigates how differences in the effects of the determinants, e.g., resulting from discrimination or behavioral differences, contribute to the gap. Kijima (2006) has used a similar decomposition technique to explain the gap in living standards between the ST/SC and the remaining Indian population. The author found that both lower human capital, but also lower returns to this capital were responsible for the gap in earnings (resulting from discrimination on the labor market). It might also be that differential effects of health determinants play a role in explaining the higher child malnutrition rates within the ST/SC as compared to the remaining population. Babu *et al.* (2001) e.g., indicate that ST/SC households felt discriminated against when consulting health care facilities (see also Ali *et al.* (2006) for a discussion on how culture influences the consultation process with a general practicioner). A lower compliance rate can result in differential health effects of health care as well. For example, Maiti *et al.* (2005) show that tribal pregnant women in Jharkhand (India) were less likely to consume all the iron and folic acid tablets they were given than were non-tribal women. Furthermore, in a study of health care use among pregnant women in Ladakh (India), Wiley (2002) found that idiosyncratic characteristics of the health practitioner played an important role in women's decision to use prenatal care.

To our knowledge there has been no study using this type of decomposition to study inequalities in child malnutrition in India.

Methods

Measuring nutritional status

Anthropometric data on the height-for-age of children under the age of three were used to assess their nutritional status. It is generally assumed that children all over the world have much of the same growth potential, certainly up to the age of seven (De Onis and Blossner 1997). If a child is chronically malnourished, it will have a growth deficit relative to what is considered a 'healthy' child. Height-for-age z scores were calculated as the difference between the child's height and the median height of children of the same age and sex in a healthy reference population, divided by the standard deviation of that reference population. This paper uses the new growth standards that were released by the World Health Organization in 2006 (World Health Organization Multicentre Growth Reference Study Group 2006). We checked robustness of results when using the older US National Center for Health Statistics (NCHS) reference population (WHO 1995). In the regression and decomposition analysis, the negative of the z-score is used as dependent variable. This facilitates interpretation since it has a positive mean and is increasing in malnutrition (Wagstaff *et al.* 2003). In the descriptive analysis, a child is considered stunted if its height falls two standard deviations below the median height of children of the same age and gender in the reference population. The results presented in this paper were also generally confirmed when using stunting and severe stunting (height-for-age below minus three standard deviations) as malnutrition indicators in the decomposition analysis.

Decomposing the gap in nutritional status between the Scheduled Tribes and Scheduled Castes (ST/SC) and the remaining population

A Blinder–Oaxaca analysis was used to decompose the gap in average height-for-age z scores between the ST/SC and the remaining Indian population (Winsborough and Dickenson 1971, Blinder 1973, Oaxaca 1973, van de Walle and Gunewardena 2001). This method allows distinguishing between the two different causes of the gap: (1) differences in the distribution of the determinants and (2) differences in the effects of these determinants across ST/SC and the remaining population. More formally, let y_i be the (negative) height-for-age z-score of child i. Children belong to the ST/SC (group 1) or to the remaining population (group 2). For the sake of simplicity, assume that height-for-age z scores are explained by only one determinant x, according to a linear regression model. The effect of x is allowed to vary between the ST/SC and the remaining population:

$$\begin{cases} y_i = \beta^1 x_i + \varepsilon_i \text{ if child } i \text{ belongs to group 1} \\ \mathrm{y_j} = \beta^2 x_j + \varepsilon_j \text{ if child } j \text{ belongs to group 2} \end{cases}$$

The gap in the average height-for-age z scores between the ST/SC and the remaining population is then equal to:

$$\bar{\mathrm{y}}^2 - \bar{\mathrm{y}}^1 = \beta^2 \bar{\mathrm{x}}^2 - \beta^1 \bar{\mathrm{x}}^1$$

where $\overline{x}^1$ en $\overline{x}^2$ are the average levels and β^1 and β^2 are the effects of x on height-for-age for both groups. The gap in height-for-age scores can then be written as:

$$\begin{aligned}\overline{y}^2 - \overline{y}^1 &= \beta^2\overline{x}^2 - \beta^1\overline{x}^1 \\ &= (\overline{x}^2 - \overline{x}^1)\beta^1 + (\beta^2 - \beta^1)\overline{x}^1 + (\overline{x}^2 - \overline{x}^1)(\beta^2 - \beta^1) \\ &= \Delta x\beta^1 + \Delta\beta x^1 + \Delta x\Delta\beta \\ &= \mathrm{E} + \mathrm{C} + \mathrm{CE}\end{aligned}$$

where E refers to the gap in the distribution of the determinant x, C to the gap in the effect of x and CE to the interaction between both. Oaxaca (1973) proposed to incorporate the CE completely in C or E, but different alternatives have been suggested (Reimers 1983, Cotton 1988, Neumark 1988). In the remainder of the paper, results are only demonstrated for the former case, since all existing alternatives yielded comparable results.

The methodology can straightforwardly be generalized to a vector of n determinants $\mathrm{X} = [1, x_1, x_2, \ldots x_n]$. To avoid the problem of invariance to the choice of reference group when a set of dummy variables is used (see Oaxaca and Ransom 1999), we followed the approach suggested by Yun (2005). As Demographic Health Surveys (DHS) rely on multi-stage sampling procedures, standard errors were adjusted for weighting and clustering in all estimations.

Data

Data were used from the 1998/1999 Indian DHS, which contains anthropometric data for 24,712 children aged 0–3 years. After deleting observations with missing background observations, the sample contained 23,529 observations, with 7807 children belonging to ST/SC. Those children that not belong to the ST/SC are hereinafter referred to as 'the remaining population,' whereas the total sample is referred to as the 'total population.'

The nutritional status of a child is specified to be a linear function of child, maternal and household level characteristics. The definition and construction of the explanatory variables is shown in Table 1.

Firstly, we include age and sex of the child as explanatory variables. Apart from having a biological effect on a child's nutritional status, gender differences may also result from differential preferences for having boys than for girls (Clark 2000, Griffiths *et al.* 2002, Bhargava 2003). Also on the child level, we include an indicator for short birth intervals and a variable capturing the birth order of the child. Rapid succession of births places a heavy burden on the mother's reproductive and nutritional resources, and also increases competition for the scarce resources within the household (Bhargava 2003). We also include variables capturing the age of the mother at the time of birth. Very young mothers can be confronted with worse infant health because of physiological immaturity and social and psychological stress that come with child bearing at young age. Also good infant feeding practices can have a substantial influence on the physical development of children. Early and sustained breastfeeding is highly beneficial as breast milk contains the mix of nutrients best suited to the infant's metabolism and contains natural immunities protecting the child from infection (Brennan *et al.* 2004).

Table 1. Description of independent variables.

Variable	Description
Breastfeeding	Months of breastfeeding.
Age	Age of child is split into three categories: *age 1 =6 months*; 6 months < age 2 = 12 months; age 3 > 12.
Birth size	Size of child at birth in five categories: very large, *average*, small, very small.
Sex	Sex of child: male (1), female (0).
State	State in which household is located: Andra Pradesh, Assam, Bihar, Goa, Gujarat, Haryana, Himachal Pradesh, Jammu, Karnataka, Kerala, Madhya Pradesh, Maharashtra, Manipur, Meghalaya, Mizoram, Nagaland, Orissa, Punjab, Rajasthan, Sikkim, Tamil Nadu, West Bengal, *Uttar Pradesh*, New Delhi, Arunchal Pradesh, Tripura.
Urban	Urban location (1), rural location (0).
Wealth	An indicator for household wealth was estimated through principal component analysis (Filmer and Pritchett 2001, Hong 2006). This wealth variable was based upon a broad range of assets and living conditions, similar to the wealth indices created by Gwatkin *et al.* (2000), but without including the variables relating to water sources and toilet facilities. The continuous indicator is used to create wealth thirds: poorest, middle, *richest*.
Toilet	Whether household has a toilet facility (1–0). The following facilities were included: own flush toilet, shared flush toilet, public flush toilet, own pit toilet, shared pit toilet, public pit toilet.
Water	Whether household has access to piped water (1–0).
Birth order	Order in which the child is born.
Risky birth interval	Whether there were less than 24 months between the child's birth and the birth of the previous child (1–0).
Maternal education	Education level of the mother split into six categories: *no education*, incomplete primary, primary, incomplete secondary, secondary, higher.
Paternal education	Education level of the father split into six categories: *no education*, incomplete primary, primary, incomplete secondary, secondary, higher.
Use of health services	Use of health services (*low*, moderate, high) estimated by principal component analysis. The indicator combines skilled birth attendance, antenatal care and recommended vaccinations (BCG, DPT3, polio, measles) (see Larrea and Kawachi 2005, Van de Poel *et al.* 2007).
Contraception	Whether the mother has ever used modern contraception (pill, IUD, injections, diaphragm, female/male condom, female/male sterilization, implants, jelly, lactational amenorrhea).
Maternal age at birth	Maternal age at birth is split into three categories: <20 years, *20–40 years*, >40 years.
Media	Whether mother listened to a radio, watched television or read a newspaper at least once a week (1/0).

Note: Italic categories are used as reference category in the regression models.

Regarding household level characteristics, especially maternal education has been considered as an important determinant of child health (Caldwell 1979, Cleland and van Ginneken 1988, Hobcraft 1993). Education may affect child health through knowledge of health production (Grossman 1972) but also through the empowerment of women within the household and the consequent priority given to child health in household resource allocation (Caldwell 1979, Hobcraft 1993). Mother's familiarity with contraception can also reflect empowerment of women and therefore positively impact on their children's nutritional status (Birdsall and Chester 1987). We also use father's education in this study, as it has been shown that certain behaviors and practices which may affect child health and nutrition are highly dependent on characteristics of the father, particularly his level of education (Fotso and Kuate-Defo 2005). Furthermore, income and wealth can raise nutritional status through the purchase of food, medicines and access to health care, but may also operate through exposure to environmental contamination (Hong 2006). The World Health Organization's 2002 World Health Report (WHO 2002) showed that unsafe water, poor sanitation, and hygiene are the cause of 4–8% of the overall burden of diseases in developing countries and nine-tenths of diarrheal diseases, a major contributor to malnutrition and mortality. There is also an evidence of a strong association between sanitation and child health (Esrey *et al.* 1991, Mohan 2005). We also include an index of health services to capture the effects of access and use of basic health care services (Larrea and Kawachi 2005, Van de Poel *et al.* 2007). Furthermore, we control for mother's exposure to media, as it has been shown that this is negatively correlated with child malnutrition (Griffiths *et al.* 2002, Brennan *et al.* 2004). Finally, we include an urban/rural indicator, and state effects. The latter should capture state-level differences in e.g., health care provision and regional development.

For 13% of the children below three years of age, anthropometric scores were missing because they were absent at the time of interview. To the extent that this absence is not random this could introduce a problem of selection bias. A logit model explaining the selection in the sample (on the covariates) was used to check for this. This analysis did not point to selection problems regarding parental education, wealth, urban location, child's age, sex, birth order and size, mother's age at childbirth and short birth interval. But children of whom the mother was breastfeeding, familiar with contraception, using health care and exposed to the media were more likely to be included in the sample. Furthermore, state of residence and sanitation variables differed significantly across the included and excluded observations. We have used Heckman selection models (using different excluding restrictions) and confirmed that coefficients were generally similar to ones presented hereafter.

Results

Table 2 shows summary statistics for the ST and SC separately, the ST/SC jointly, the remaining and total population.

It shows that the SC and ST were comparable for most variables (the SC had a higher use of health care services and a slightly higher level of maternal education, familiarity with contraception and access to safe water). Both ST and SC were found to be disadvantaged for most determinants compared to the remaining population. Children belonging to ST/SC were more prevalent in rural areas and in lower wealth quintiles, had less educated parents and were less likely to use health care services. In both ST and SC, about 57% of the children were stunted; whereas the stunting rate was about 47% in the remaining population.

Table 2. Means of determinants across different population groups.

		Total population	Remaining population	ST/SC	SC	ST
Maternal education	Incomplete primary	0.09	0.09	0.09	0.10	0.09
	Primary	0.07	0.08	0.06	0.07	0.04
	Incomplete secondary	0.18	0.20	0.13	0.14	0.12
	Secondary	0.07	0.08	0.03	0.04	0.02
	Secondary and higher	0.09	0.11	0.04	0.04	0.03
Paternal education	Incomplete primary	0.10	0.10	0.11	0.11	0.12
	Primary	0.08	0.07	0.09	0.09	0.08
	Incomplete secondary	0.24	0.24	0.22	0.23	0.21
	Secondary	0.13	0.15	0.09	0.10	0.06
	Secondary and higher	0.19	0.22	0.12	0.13	0.10
Wealth quintiles	Quintile 1	0.42	0.35	0.57	0.54	0.63
	Quintile 2	0.33	0.34	0.31	0.33	0.28
Breastfeeding		13.77	13.58	14.23	14.18	14.34
State	Andhra Pradesh	0.08	0.08	0.07	0.08	0.05
	Assam	0.02	0.02	0.02	0.01	0.04
	Bihar	0.11	0.11	0.10	0.12	0.07
	Goa	0.00	0.00	0.00	0.00	0.00
	Gujarat	0.05	0.04	0.06	0.04	0.10
	Haryana	0.02	0.02	0.02	0.03	0.00
	Himachal Pradesh	0.01	0.01	0.00	0.01	0.00
	Jammu	0.01	0.01	0.01	0.01	0.00
	Karnataka	0.05	0.05	0.04	0.05	0.03
	Kerala	0.03	0.04	0.01	0.01	0.00
	Madhya Pradesh	0.09	0.08	0.12	0.07	0.21
	Maharashtra	0.11	0.11	0.09	0.07	0.12
	Manipur	0.00	0.00	0.00	0.00	0.01
	Mizoram	0.00	0.00	0.00	0.00	0.01
	Meghalaya	0.00	0.00	0.01	0.00	0.03
	Nagaland	0.00	0.00	0.01	0.00	0.02
	Orissa	0.04	0.03	0.06	0.04	0.09
	Punjab	0.02	0.02	0.03	0.04	0.00
	Rajasthan	0.06	0.06	0.07	0.06	0.10
	Sikkim	0.00	0.00	0.00	0.00	0.00
	Tamil Nadu	0.07	0.07	0.06	0.08	0.01
	West Bengal	0.08	0.08	0.09	0.10	0.06
	New Delhi	0.01	0.01	0.01	0.01	0.00
	Arunachal Pradesh	0.00	0.00	0.00	0.00	0.01
	Tripura	0.00	0.00	0.00	0.00	0.00
Urban location		0.24	0.27	0.17	0.20	0.11
Water		0.35	0.38	0.28	0.31	0.22
Toilet		0.32	0.37	0.18	0.19	0.16
Contraception		0.35	0.38	0.29	0.30	0.26

Table 2 (*Continued*)

		Total population	Remaining population	ST/SC	SC	ST
Maternal age at birth	<20 years	0.24	0.23	0.25	0.25	0.25
	>40 years	0.01	0.01	0.01	0.01	0.02
Risky birth interval		0.16	0.16	0.16	0.16	0.16
Birth order		2.72	2.63	2.95	2.88	3.08
Use of health services	Moderate	0.33	0.33	0.34	0.34	0.34
	High	0.34	0.37	0.26	0.30	0.17
Size at birth	Very large	0.15	0.15	0.15	0.14	0.15
	Small	0.19	0.19	0.21	0.19	0.24
	Very small	0.04	0.04	0.05	0.05	0.05
Age of child	6–12months	0.17	0.17	0.16	0.16	0.17
	>24months	0.63	0.63	0.63	0.63	0.62
Child is male		0.52	0.52	0.51	0.52	0.51
Media		0.57	0.62	0.46	0.50	0.37
Observations		23,529	15,722	7807	4342	3465

To see whether there was evidence of differences in the effects of the determinants, a regression was done of the height-for-age z score on the determinants interacted with the dummy variable separating ST/SC from the remaining population. The joint test on these interaction effects was highly significant ($p < 0.001$), indicating that a Blinder–Oaxaca decomposition made sense in this context. Significant interactions include the poorest wealth quintile, Karnataka, Punjab, Tamil Nadu, Tripura, urban, toilet, very small birth size, sex of child and media exposure. Regression results can be consulted in the Appendix 1 but are not discussed in detail for the sake of parsimony.

The ST/SC had an average (negative) height-for-age z-score of 2.19, compared to 1.87 for the remaining population, the difference being highly significant ($p < 0.001$), indicating that malnutrition was more prevalent in the ST/SC than in the remaining population. The decomposition results are shown in Figure 1. The gap in malnutrition can be attributed to two components. Differences in the distribution of the determinants were responsible for about 65% of the gap between the ST/SC and the remaining population, while differences in their effects contributed 38% to the gap. Both components were highly statistically significant. The interaction effect was very small (negative) and insignificant.

Figure 2 shows how differences in the distribution of each determinant contributed separately to the first part of the gap. A negative contribution means that the determinant was narrowing the gap between the ST/SC and the remaining population. In particular, wealth, the use of health services and mother's education were the most important but contributions of father's education, contraception, birth size and order, and duration of breastfeeding were also significant at the 10% level.

Figure 3 shows the same detailed decomposition of the part of the gap that was caused by different effects of the determinants (C). It shows that there were a lot of offsetting factors, but that only the contributions of being located in urban areas, having a toilet facility, birth size, media exposure, and sex of child were statistically significant. The positive contribution of child sex comes from the fact that male children within the ST/SC are more prone to being malnourished than those within

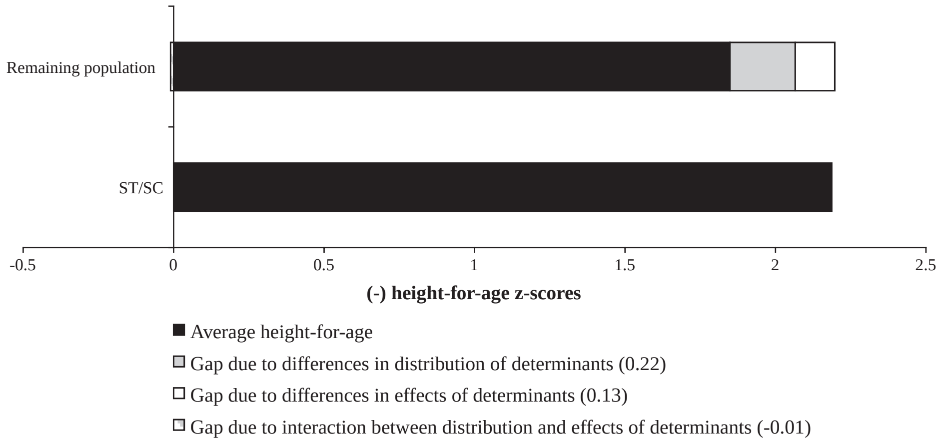

Figure 1. Decomposition of the gap in average height-for-age z scores between ST/SC and the remaining population.

the remaining population. The higher prevalence of malnutrition among boys as compared to girls has also been found in other studies (see e.g., Vella *et al.* 1992, Griffiths *et al.* 2002, Larrea and Kawachi 2005) and is most likely a biological phenomenon rather than a social one. It is only toward the end of the first years of life that the child will be competing for a share of family resources and that mothers have greater potential to discriminate in food allocation as the child stops breastfeeding.

On the other hand, the negative contribution of having a toilet facility derives from the fact that this variable has a more protective effect within ST/SC (regression results can be consulted in the Appendix 1).

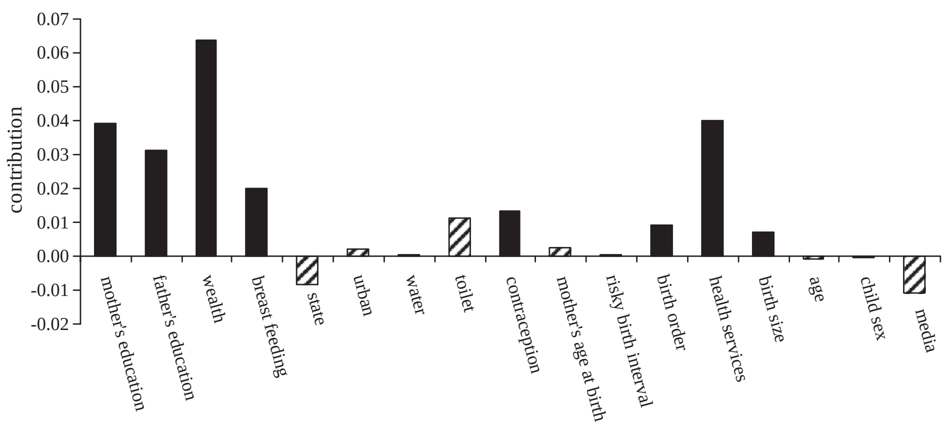

Figure 2. Contributions of differences in the distribution of the determinants of malnutrition to the total gap between SC/ST and the remaining population. Striped bars indicate insignificance at the 10% level.

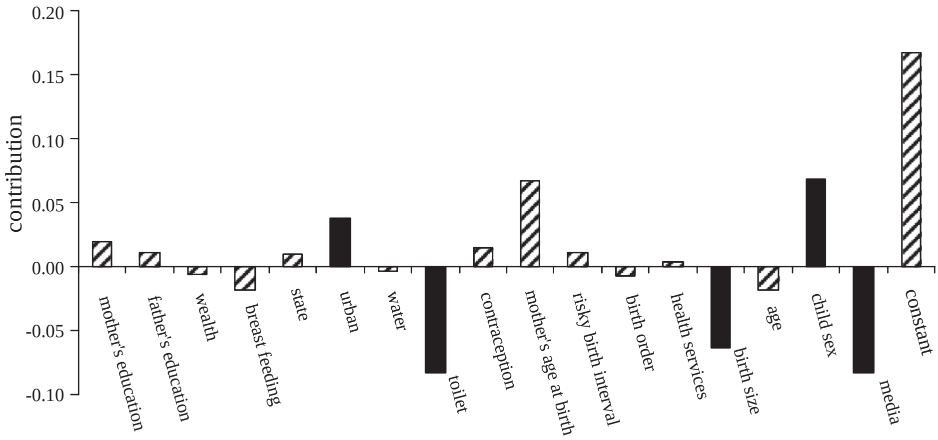

Figure 3. Contributions of differences in the effects of the determinants of malnutrition to the total gap between SC/ST and the remaining population. Striped bars indicate insignificance at the 10% level.

To gain insight into the possible causes of the ST/SC's lower levels of health care services use and education, average distances to health care and educational centers for women living in rural areas are listed in Table 3. It shows that in rural areas, ST/SC and the remaining population were located at comparable distances from these centers, although, the ST were slightly more disadvantaged than the SC. DHS has no information on these distances in urban areas.

Discussion

Disaggregating the effects of determinants of nutritional status across different population groups can provide new insights and may prompt different reactions by policy makers. The results of this paper reveal that ST/SC are consistently at a disadvantage across nearly all determinants affecting childhood nutritional status. We use a Blinder–Oaxaca type decomposition to explain the difference in average child malnutrition rates between the SC/ST and the remaining Indian population. The use of this method allows quantifying the proportion of the gap that is due to differences in the distribution of determinants, and also the part due to differences in the effects of determinants. The results reveal that although the majority of the gap can be attributed to differences in the distribution of malnutrition determinants between the SC/ST and the remaining population, differences in their effects also play an important role.

The ST/SC's lower levels of wealth, parents' education and use of health care services were most strongly related to this first part of the gap. Other contributions come from familiarity with contraception, breastfeeding, birth size and birth order. Within the part of the gap caused by differences in the effects of the determinants, we found offsetting factors. Differences in the coefficients of having a toilet facility, birth size and exposure to the media were actually reducing the gap in average malnutrition rates. This can be explained by the fact that these factors were all more protective of child malnutrition within the ST/SC than within the remaining

Table 3. Average distances to health and educational facilities for different population groups. Data is based upon the total sample of women in the DHS survey that were living in rural areas.

	ST/SC	ST	SC	Remaining population
Average distance (in km) to				
Health facilities				
Sub-centre	4.85	5.47	4.52	4.76
Primary health centre	11.30	11.81	11.03	11.47
Community health centre	20.15	20.63	19.89	20.29
Government dispensary	18.15	18.25	18.09	18.19
Government hospital	26.40	27.60	25.74	25.98
Private clinic	12.24	13.67	11.48	12.08
Private hospital	25.14	26.97	24.14	24.76
Educational facilities				
Primary school	0.68	0.76	0.65	0.60
Middle school	2.48	2.47	2.49	2.37
Secondary school	6.08	6.80	5.69	5.92
Higher secondary school	12.69	14.07	11.94	12.15
College	25.21	26.35	24.58	25.31
Number of observations	20,466	9064	11,402	42,043

Indian population. Given the much lower averages of having a toilet facility or media exposure within the ST/SC, it is likely that these variables pick up the effect of those ST/SC households that are more familiar with modern child caring practices.

On the other hand, differences in the effects of child sex and urban location positively contribute to the gap in malnutrition rates. The latter contribution arises because the ST/SC children in urban areas are more likely to be malnourished than their urban peers in the remaining population, which is likely to be caused by the much higher concentration of ST/SC households in urban slums as compared to the remaining population (India Census 2001). Whereas other households in urban households can reap the benefits of higher incomes, better infrastructure, etc., it seems that ST/SC households are more likely to live in urban slums where conditions are detrimental to their children's health.

An in-depth analysis of the reasons for the lower levels of education and health care use is outside the scope of this paper. In the quest to increase the use of health care services and education among ST/SC, policy makers will have to take into account all the barriers to these services. It was found that within rural areas ST/SC are not necessarily located further from educational and health care facilities, which indicates that it is not only a matter of physical proximity. Access to health care is made up of different components (steps) and 'social exclusion' is one component as well as physical accessibility. The Tanahashi (1978) Framework defines the (five) stages of measuring coverage of health services as: (i) availability; (ii) accessibility; (iii) acceptability; (iv) contact and (v) effectiveness of client services. Availability (i) has to do with the percentage of a population for whom the service or intervention is available. Accessibility (ii) refers to the proportion of a population who can reach and use the service. Acceptability (iii) is defined by the willingness of people to use the service. Contact (iv) is expressed in terms of the proportion of a population that actually uses the service, and effectiveness (v) relates to the percentage of a population who receive effective services. The low difference in physical accessibility between the SC/ST and the remaining population indicates that differences in use are also related to differences in the other components. Basu (1992) has drawn attention to the cultural factors underlying health care seeking behavior of the SC/ST in India, and Babu *et al.* (2001) also indicate that ST/SC households felt discriminated against when consulting health care facilities. Wiley (2002) found that idiosyncratic characteristics of the health practitioner played an important role in pregnant women's decision to use prenatal care.

The use of public services such as education and basic health care should be addressed if policy makers want to reduce the gap in child malnutrition between the ST/SC and the remaining population. Unfortunately, formal schooling offers only a long-term solution, for there are long lags between the time periods in which girls enroll in primary school and subsequently, become mothers. One intermediate solution would be to focus on literacy training form older women (Lee and Mason 2005). Improving the ways health care systems interact with illiterate mothers offers another possible solution.

It is important to note that this paper is showing the factors that are associated with the malnutrition gap between the ST/SC and the remaining population. These results are subject to the usual caveats regarding the causal interpretation of cross-sectional results. Focusing on child nutritional status avoids much of the reverse causality between the income and health that is usually present in microeconomic studies. However, variables such as birth interval, breastfeeding and birth order might still be endogenous in the sense that they might be correlated with unobserved factors that affect the health and survival chances of children within the same household. To gain insights into the severity of these endogeneity problems we conducted the analysis excluding these possible endogenous variables. Again, education, wealth and health care use were the most important contributors to the gap in infant mortality rates. To avoid endogeneity of health care use, it would be better to use data on proximity/availability of care. However, this information is not available for urban areas in the Indian DHS. Another option would be to predict health care use, but we were not able to find strong predictors for health care.

A further limitation is that we could only include children of living mothers. Children of mothers who have died may have worse health status and their mothers may have had systematically different characteristics (see e.g., Lindblade *et al.* 2003). This could lead to a selection problem, but since neither these children nor their mothers could be observed, this problem could not be corrected for.

Conclusion

This paper illustrates that it is important to consider both differences in the distribution of health determinants and differences in their effects as the latter can point to behavioral differences or discriminatory behavior, which are very relevant when interest lies in investigating ethnic inequalities in health. The Blinder–Oaxaca decomposition is developed to explain the gap in outcomes between two groups and explicitly takes into account both these aspects. Although one can also explore heterogeneity in the effects of health determinants using interaction effects in a conventional regression framework (see e.g., Hong 2006, Subramanian *et al.* 2006a), it is generally unfeasible to include as many interactions as there are covariates while still retaining a meaningful interpretation of the coefficients. Furthermore, to gain insight into how differences in the distribution of health determinants are explaining health inequalities, many studies rely upon stepwise regression type approaches. Although this is a useful approach if one in interested in how the distribution of a particular variable is correlated with the health gap (e.g., socioeconomic status), it is more difficult to apply when one wants to quantify the relative contributions of all health determinants to the gap. Furthermore, the Blinder–Oaxaca decomposition is invariant to the order in which one controls for the covariates, whereas this can be problematic in stepwise regression.

In summary, we found that the higher malnutrition rates of ST/SC are firstly caused by their lower socioeconomic status and lower use of health care and parental education. Although we did find differential effects of some determinants, the results did not point to important discrimination with regards to health care or schooling. Those ST/SC children of whom the mother accessed health care services during and after giving birth experienced the same health benefits from this care as their peers in the remaining population. However, this does not rule out the possibility that discriminatory practices are partly responsible for the ST/SC's lower use of health care and education. Access to these services is made up out of several components comprising both physical access and cultural sensitivity. As our results did not indicate major differences in physical proximity to health care centers between the ST/SC and the remaining population, this suggests that policy makers need to take into account all other barriers to limit the ST/SC's use of these services.

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Appendix 1. Regression estimates the total population, the SC/ST, and the remaining population

		Total population	Remaining population	ST/SC
Maternal education	incomplete primary	−0.044	−0.035	−0.031
	primary	−0.114**	−0.082	−0.171*
	incomplete secondary	−0.143***	−0.129**	−0.145*
	secondary	−0.175***	−0.136**	−0.276**
	secondary and higher	−0.332***	−0.301***	−0.326***
Paternal education	incomplete primary	−0.078	−0.032	−0.166*
	primary	−0.084	−0.098	−0.026
	incomplete secondary	−0.104***	−0.102**	−0.099
	secondary	−0.115***	−0.115**	−0.096
	secondary and higher	−0.212***	−0.247***	−0.104
Wealth quintiles	poorest	**0.289*****	**0.324*****	**0.106**
	middle	0.183***	0.195***	0.055
Breastfeeding		0.030***	0.031***	0.029***
State	Andhra Pradesh	−0.157**	−0.137	−0.237**
	Assam	−0.148	−0.018	−0.425**
	Bihar	−0.161**	−0.135*	−0.233**
	Goa	−0.702***	−0.669***	-0.954***
	Gujarat	−0.031	−0.015	−0.136
	Haryana	0.170**	0.178**	0.114
	Himachal Pradesh	−0.019	−0.02	−0.082
	Jammu	−0.433***	−0.420***	−0.594***
	Karnataka	**−0.413*****	**−0.356*****	**−0.625*****
	Kerala	−0.475***	−0.489***	−0.494*
	Madhya Pradesh	−0.138**	−0.147**	−0.177*
	Maharashtra	−0.226***	−0.251***	−0.210*
	Manipur	−0.458***	−0.451***	−0.492***
	Mizoram	−0.395***	−1.341*	−0.445***
	Meghalaya	−0.471***	−0.605***	−0.451***
	Nagaland	−0.814***	−0.782**	-0.836***
	Orissa	−0.431***	−0.493***	−0.407***
	Punjab	**−0.067**	**−0.221****	**0.086**
	Rajasthan	−0.019	−0.038	−0.037
	Sikkim	−0.614***	−0.609***	−0.675***
	Tamil Nadu	**−0.509*****	**−0.611*****	**−0.278****
	West Bengal	−0.274***	−0.277***	−0.323***
	New Delhi	−0.058	−0.133	0.065
	Arunachal Pradesh	−1.216***	−0.939***	−1.288***
	Tripura	**−0.555*****	**−0.318**	**−0.867*****
Urban location		**0.018**	**−0.02**	**0.119***
Water		−0.011	−0.005	−0.016
Toilet		**−0.123*****	**−0.058**	**−0.280*****
Contraception		−0.150***	−0.149***	−0.111*
Maternal age at birth	<20 years	0.155***	0.153***	0.149**
	>40 years	−0.229*	−0.155	−0.361

Appendix 1 (*Continued*)

		Total population	Remaining population	ST/SC
Risky birth interval		0.168***	0.144***	0.217***
Birth order		0.030***	0.029**	0.026*
Use of health services	moderate	−0.114***	−0.113***	−0.121**
	high	−0.319***	−0.344***	−0.244***
Size at birth	very large	−0.179***	−0.213***	−0.099
	small	0.244***	0.236***	0.276***
	very small	**0.471*****	**0.401*****	**0.639*****
Age of child	6–12 months	**0.627*****	**0.571*****	**0.782*****
	>24 months	1.368***	1.357***	1.417***
Child is male		**0.093*****	**0.055***	**0.186*****
Media		**0.029**	**0.067**	**−0.066**
Constant		0.736***	0.703***	0.895***
Observations		23,529	15,722	7807
R-squared		0.25	0.26	0.23

Note: * significant at 10%, ** significant at 5%, *** significant at 1%.